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REVIEW OF THE PROGRESS OF AMERICAN INVERTEBRATE PALEONTOLOGY FOR THE YEAR 1889.

BY CHARLES R. KEYES.

ALTHOUGH the number of titles is somewhat in advance, the results of studies in American invertebrate paleontology issued during the past twelve months do not compare as favorably as might be expected with those of previous years. Works of a monographical character have been numerically very limited; but a goodly proportion of the briefer papers foreshadow important publications now in a more or less advanced stage of preparation.

A very considerable number of reprints continue to appear entirely repaged. It is to be hoped that where this is found desirable the original pagination will also be allowed to remain for convenience in reference. The time and patience consumed in looking up the correct citations of repaged authors' editions detracts greatly from the value of these excerpts by thwarting the very purpose which they were designed to serve.

The small number of species described during the past year is rather surprising, but it clearly indicates that the species from the most accessible localities have been already described. It is with considerable satisfaction that the present trend of thought, as disclosed in the papers of the year, is noted; and that paleontologists have begun to appreciate more fully the direct bearing and close relations of the science to those branches dealing with the structure of animals and their distribution in time and space. The few morphological facts already brought out by the investigation of fossil forms is only suggestive of the vast and fertile field open to the student who directs his energies along these lines. Thus intimately connected with biology, the results of the study of the material already accumulated cannot but give most valuable aid in making out the phylogenetic history of the living zoölogical groups. And, indeed, the importance of this consideration cannot be overestimated in the attempt toward a complete phylogeny of organic beings. Viewed from an anatomical and embryological standpoint, the dead become rejuvenated; the "curious stones" live; the rocks disclose the great plan of life. More lasting, more useful, more worthy of contemplation are paleontological labors directed thus rather than to the indiscriminate multiplication of species, to the mere description of curiosities.

Not less important is the recognition of the mutual dependence of paleontology and stratigraphy for the attainment of the highest and most accurate results in generalizations. Heretofore these fields have been far too widely separated; and the work of one has been carried on practically independently of the other, with often very erroneous conclusions. But the present record shows that, in one instance at least, an intimate knowledge of both has been happily combined in the production of a very high grade of work.

In the Canadian *Record of Science* for July Henry M. Ami has a paper On a Species of Goniograptus from the Levis Formation, Levis, Quebec; and in the October number of the same journal, Additional Notes on *Goniograptus thureauni* McCoy, from the Levis Formation of Canada.

Charles Barrois, in the Faune de Calcaire d'Erbray (Mém. de la Soc. Geol. du Nord, tome III., April, 1889), discusses the relations of the American and European Devonian faunas; that of the region in question bearing a great resemblance to the North American Oriskany and Upper Helderberg.

Charles E. Beecher, in the Memoirs of Peabody Museum, Yale University, Vol. II., Part 1, has an important contribution to the knowledge of that rare group of silurian sponges, the Brachiospongidæ; and, in the September number of the *American Journal of Science*, a Note on the Spider *Arthrolycosa antiqua* Harger.

In the number for February 4, 1889, Vol. CVIII., of the *Comptes Rendus*, is a note on Les Blattes de l'epoque houillère, by Charles Brongniart.

Samuel Calvin describes a new species of Spirifera from the Hamilton Group near Iowa City; and Synonymy, Characters and

Distribution of *Spirifera parryana*, Hall. Both in the Bulletin of the Laboratories of Natural History of the State University of Iowa.

H. J. Carter sketches the History of known Fossil Sponges in Relation to those of the Present, in which some general considerations respecting classification are brought out. Also, Further Observations on the Foraminiferal Genus Orbitoides of d'Orbigny. The first is in the October, and the second in the March, number of the *Annals and Magazine of Natural History.*

A valuable morphological memoir on the Development of some Silurian Brachiopoda, by J. M. Clarke and Charles E. Beecher, forms Part 1., Vol. I., of the Memoirs of the New York State Museum. In the Forty-second Annual Report N. Y. State Museum the first author has: The Genus Bronteus in the Chemung Rocks of N. Y.; The Hercynian Question; and a List of Species constituting the known Fauna and Flora of the Marcellus Epoch in the State of New York.

William F. Cooper gives a Tabulated List of Fossils known to occur in the Waverly of Ohio. Bulletin Denison University, Vol. IV., pp. 123–130.

William H. Dall, in a paper on the Hinge of Pelecypods and its Development, with an Attempt toward a better Subdivision of the Group, seeks more immutable criteria than generally adopted, for the systematic arrangement of the class. *American Journal of Science* for December.

William Dawson has a Note on *Saccamia eriana* in the *American Journal of Science* for April; and on Fossil Sponges from the Beds of the Quebec Group of Sir William Logan, in the *Canadian Record of Science* for July.

In the *Annals and Magazine of Natural History* for March, P. Martin Duncan considers some Points in the Anatomy of the Species of Palæechinus; and a proposed classification. The genus is limited, and two North American forms referred to the group as now restricted.

A. F. Foerste notes some Cambrian Fossils from the Limestone of Nahant, Mass. Proc. Boston Soc. Nat. Hist., p. 291.

The Geological Department of the British Museum publishes Part 1. of an exhaustive Catalogue of the Fossil Cephalopods, by

Arthur Foord. The portion issued embraces seven families, of which are carefully drawn up the characters of each genus.

James Hall discusses some Crustacean Tracks from the Potsdam Sandstone of Port Henry, N. Y., in the Annual Report of the New York State Museum. The State Geologist's Report was also issued separately in an edition of eight hundred copies.

C. L. Herrick describes about forty new species, and considers others, in Lists of Waverly Fossils. Bulletin Denison University, Vol. IV., pp. 11–60, and continued on pp. 97–123. In the *American Geologist* for February the same writer has Notes on the Waverly Group of Ohio.

Robert T. Hill publishes a chapter on the Palæontology of the Trinity Division in the Neozoic Geology of Southwestern Arkansas (Vol. II., Ann. Rept. Ark. Geol. Sur); Palæontology of the Cretaceous Formations of Texas, Part I.; and a Check List of the Invertebrate Fossils from the Cretaceous Formations of Texas.

In the Canadian *Record of Science* for April, G. J. Hinde writes on Archæocyathus Billings, and other Genera allied thereto or Associated therewith from the Cambrian Strata of North America, Spain, Sardinia, and Scotland; and in the July number of the same journal, on a New Genus of Siliceous Sponges from the Trenton Formation at Ottawa.

Alpheus Hyatt ably discusses the Genesis of the Arietidæ in the Smithsonian Contributions to Knowledge, No. 673.

T. R. Jones has some Notes on Paleozoic Bivalve Entomostraca: North American Species. (*Can. Annals and Mag. Nat. Hist.*, 6th Series, Vol. III.)

T. Rupert Jones and J. W. Kirkby publish a paper on Some Ostracoda from the Mabou Coal-field of Nova Scotia, in the *Geological Magazine* for June. The first author also describes some species of Palæozoic Ostracoda from Pennsylvania, U. S., in the *American Geologist* for December.

Charles R. Keyes has a list and some notes on the Löss (Post-Pliocene) fossils of the State, in an Annotated Catalogue of the Mollusca of Iowa (Bulletin of Essex Institute, Vol. XX.); Soleniscus, its Generic Characters and Relations, in THE AMERI-

CAN NATURALIST, May number; Variations Exhibited by a Carbonic Gasteropod, *American Geologist* for June; Note on the Distribution of Certain Löss Fossils, *American Geologist*, August, 1889; Lower Carbonic Gastropoda from Burlington, Iowa, Proceedings Academy Natural Sciences, Philadelphia, for September 24, 1889; the American Species of Polyphemopsis, ibid.; Sphærodoma; A Genus of Fossil Gastropods, ibid.; The Carboniferous Echinodermata of the Mississippi Basin, *American Journal of Science*, September number; and The Sub-generic Groups of Naticopsis, *American Geologist* for October.

F. H. Knowlton describes a Problematic Organism from the Devonian at the Falls of the Ohio, in the *American Journal of Science*, March number.

Joseph Leidy, in the Ann. Rept. Geol. Sur. Pa., for 1887, has a Notice of Fossils in Caves and Crevices of the Limestone Rocks of Pennsylvania; chiefly vertebrates.

J. P. Lesley publishes as Report (P. 4) of the Second Pennsylvania Geological Survey, a Dictionary of the Fossils of Pennsylvania and neighboring States.

In the *American Geologist* for March Jules Marcou describes the Original Locality of *Gryphæa pitcheri*.

G. F. Mathew has: A Second Note on Stenotheca, in the *Geological Magazine*, May number; On the Cambrian Organisms in Acadia, in the Canadian *Record of Science* for July; and On Remarkable Organisms of the Upper Silurian and Devonian of New Brunswick, in the Transactions of the Royal Society of Canada, Vol. VI.

S. A. Miller has issued North American Geology and Paleontology, with a catalogue of the species described to date.

Kentucky Fossil Shells from the Silurian and Devonian rocks are described by Henry Nettleroth in one of the monographs of the Ky. Geol. Survey.

H. A. Nicholson discusses the Relations between the Genera Syringolites Hinde, and Roemeria Ed. & H., and the Genus Caliapora Schlüter, in the October number of the *Geol. Mag.*

A. S. Packard briefly notes some Recent Discoveries in the Carboniferous Flora and Fauna of Rhode Island, *American Jour-*

nal of Science, May; and in the Proceedings of the Boston Society of Natural History, Vol. XXIV., pp. 209–11, are some Palæontological Notes.

E. N. S. Ringueberg reviews the Calceocrinidæ, with Descriptions of New Species, in Annals of N. Y. Acad. Science, Vol. IV., 1889.

Ferdinand Roemer has a paper, bearing the date 1888, Ueber eine durch die Häufigkeit Hippuritenartiger Chamiden ausgezeichnete Fauna der oberturonen Kreide von Texas.

J. M. Safford and A. W. Vogdes, in the Proceedings Academy Natural Sciences of Philadelphia, describe New Species of Fossil Crustacea from the lower Silurian of Tennessee.

Charles Schuchert gives a List of Fossils occurring in the Oriskany Sandstone of Maryland, New York, and Ontario. Annual Report New York State Museum for 1888.

Samuel Scudder has the Oldest Known Insect Larva, *Mormolycoïdes articulatus*, from the Connecticut river Rocks. Mem. Boston Soc. Nat. Hist., Vol. III., No. 13.

N. S. Shaler notes the Occurrence of Fossils of the Cretaceous Age on the Island of Martha's Vineyard, in the Bulletin Museum of Comparative Zoölogy, Vol. XVI., No. 5.

In the *American Geologist* for August some New Characters of *Dophyphyllum simcoense* Billings are given by Will H. Sherzer.

Charles Wachsmuth and Frank Springer have, in the Proceedings of the Academy of Natural Sciences of Philadelphia, dated November 27, 1888, two morphological contributions on the Discovery of the Ventral Structure of Taxocrinus and Haplocrinus, and Consequent Modifications in the Classification of the Crinoidea; and Crotalocrinus: Its Structure and Zoölogical Position.

Charles D. Walcott has an important article in the May and July numbers of the *American Journal of Science* on the Stratigraphic Position of the Olenellus Fauna in North America and Europe. In advance sheets of the Proceedings of the U. S. National Museum for 1888, the same author describes New Genera and Species of Fossils from the Middle Cambrian; a Fossil Lingula Preserving the Cast of the Peduncle; and a New

Genus and Species of Inarticulate Brachiopod from the Trenton Limestone.

Charles A. White considers the Permian Formation of Texas in THE AMERICAN NATURALIST for January; and Invertebrate Fossils from the Pacific Coast in Bulletin 51, U. S. Geological Survey.

J. F. Whiteaves, in Contributions to Canadian Palæontology, Vol. I., Part 2, has: On some Fossils from the Hamilton Formation of Ontario; Fossils of the Triassic Rocks of British Columbia; and on Some Cretaceous Fossils from British Columbia. In the Transactions Royal Society of Canada, Vol. VII., Descriptions of Eight New Species of Fossils from the Cambro-Silurian Rocks of Manitoba.

The Bulletin of the American Museum of Natural History, Vol. II., No. 2, contains, by R. P. Whitfield, Observations on some Imperfectly Known Fossils from the Calciferous Sandrock of Lake Champlain, and Descriptions of several New Forms; Additional Notes on *Asaphus canalis* Conrad; Description of a New Form of Fossil balanoid Cirripede from the Marcellus Shale of New York; and a Note on the Faunal Resemblance between the Cretaceous Formation of New Jersey and that of the Gulf States.

H. S. Williams has an abstract in the Proceedings A. A. A. A. for 1888 on the Use of Fossils in Determining the Age of Geological Terranes; and in the *American Geologist* for April, the Relation of the Devonian Fauna of Iowa.

N. H. Winchell notices the Discovery of Lingula and Paradoxides in the Red Quartzites of Minnesota, in the Bulletin Minnesota Academy of Natural Science, Vol. III.

Anthony Woodward, in the Journal of the New York Microscopical Society, gives a Preliminary List of Foraminifera from Post-Pliocene Sand at Santa Barbara, California.

Henry Woodward notes the Discovery of Turrilepas in the Utica Formation of Ottawa, Canada, in the *Geo. Mag.* for June.

E. O. Ulrich has some Polyzoa and Ostracoda from the Cambro-Silurian Rocks of Manitoba, in Contributions to the Micro-Palæontology of the Cambro-Silurian Rocks of Canada, Part 3; on Lingulasma, a new Genus, and Eight New Species of Lingula and Trematis, in *Amer. Geol.* for June; and in the same journal for April, Preliminary Description of New Lower Silurian Sponges.

Warren Upham mentions some Marine Shells and Fragments of Shells in the Till near Boston, in *American Journal of Science*, May number.

AUTOTOMY IN THE CRAB.

BY E. A. ANDREWS.

THAT crabs when roughly handled may throw off one or more legs at a point close to the body, is a fact well-known and often observed.

As little bleeding takes place in such cases, and as the crab may thus escape complete destruction, and is able to grow new legs, this power of self-amputation is of evident advantage to the species, and might at first sight be regarded as an intelligent act consciously performed by the crab under certain circumstances.

The experimental work of Léon Fredericq has, however, demonstrated that such amputations are merely reflex acts brought about by special mechanisms, and may be included with similar phenomena in other animals under the term "Autotomy."

From the various publications upon this subject we may abstract the chief facts relating to the crab, as given by the above author in his *Travaux du Laboratoire*, I.-II., 1887–8.

He there shows that this rupture of the limbs is not due to fragility, since the weight necessary to break off a limb is many times that of the crab's body, and the rupture thus produced is an irregular one, taking place generally at some joint of the limb, and not at the normal "plane of rupture."

That, moreover, this autotomy is not a voluntary act was shown as follows: A crab when fastened by one or more legs endeavors to escape, but does not hit upon the expedient of throwing off a fastened leg, though if even a free leg is seriously injured, the crab then amputates it. When the brain (supra-